



United States
Department Of
Agriculture

Forest
Service

Shasta-Trinity
National Forests

Lat 39.74885 Lon -122.96044

Reply To: 3420

Date: August 24, 1989

Subject: Evaluation of Ponderosa Pine Stands for Dwarf
Mistletoe Suppression, Covelo Ranger District (Report No. N89-17)

To: Forest Supervisor, Mendocino National Forest

On August 2, 1989, Dave Schultz, Entomologist, and I visited with Debbie Fleming, Floyd Barney, and Carol Brinkerhoff on the Covelo Ranger District. The purpose of our visit was to examine stands with ponderosa pine infested by western dwarf mistletoe, Arceuthobium campylopodum, for consideration for dwarf mistletoe suppression and possible FPM suppression funding. We looked at five areas on the District that will be discussed separately.

BIOLOGY OF WESTERN DWARF MISTLETOE

Western dwarf mistletoe is a major cause of mortality, growth loss, and reduced vigor of ponderosa pine. Past statewide surveys indicate that during drought years, dwarf mistletoes as a group are involved in about 40% of the conifer mortality. During years of normal precipitation, this proportion changes to about 20%. Dwarf mistletoes also cause significant declines in tree growth and stand productivity. The amount of growth reduction depends on the extent of infection, both the number of infected trees and the intensity of infections, and site quality. Means of determining the level of decline for a specific stand have not been developed, but a rough estimate for lightly infected stands on an average site is 10 cu.ft./ac/year. This is 6-8% of the mean annual increment. Stands with heavier mistletoe infections would have greater impacts on growth.

Western dwarf mistletoe requires living host material to survive, primarily ponderosa, Jeffrey, and knobcone pines. Evidence of infection includes the presence of aerial shoots, swollen branches, and witches' brooms. Aerial shoots produce seed that are forcibly discharged in the fall. These seeds have a sticky coating that allows them to adhere to surfaces they contact. Seed that land on needles and twigs of a host will overwinter there and germinate the following spring. The radicle of the seed penetrates the bark of 1-year-old twigs and develops an endophytic system in the inner bark and sapwood. In 2-4 years, this infection produces new aerial shoots which flower and produce seed in another 2-4 years.

The spread of dwarf mistletoe is limited to the distance travelled by the seed, which from overstory to understory is usually 20-60 feet. A rule of thumb is that dwarf mistletoes can spread a horizontal distance equal to the height of the plants in the infected tree as long as the seed are not intercepted. The





actual spread rate through an even-aged, single species stand is 1-2 feet per year. Vertical spread in a tree crown is about 4 inches per year.

BUCKHORN RIDGE

These mixed conifer stands are located along Buckhorn Ridge (T. 22 N., R. 10 W., sections 26, 27, 34). They are comprised of ponderosa pine, incense-cedar, white fir, Douglas-fir, sugar pine, and black oak in a multiple layer stand structure. The area was selectively harvested several years ago, leaving understocked areas and dwarf mistletoe infested overstory ponderosa pines. Natural regeneration, mainly of ponderosa pine, is occurring in some of the openings. Funds were not collected from the sale for mistletoe suppression efforts.

The District is considering the regeneration of some of the openings and understocked areas with ponderosa pine. They recognize the hazard of dwarf mistletoe infection of ponderosa pine regeneration, both planted and natural, from any infected overstory. Many of the infected trees are submerchantable or not merchantable and another timber sale is not feasible at this time.

Management Alternatives

1. No Action. If the District regenerates the openings and includes ponderosa pine in the planting mix, then many of the planted pines will become infected by dwarf mistletoe. The natural regeneration of ponderosa pine that is, or becomes, established is also at risk of being infected. Because of their size and the continuous infections from above, these trees will become stunted and deformed. They will never reach their growth potential and many may never make satisfactory crop trees. As they get larger, they will become better habitat for bark beetles, such as western pine beetle (Dendroctonus brevicomis). A high level of dwarf mistletoe infection in a tree increases its susceptibility to successful bark beetle attack. Because of the ability of bark beetles to produce pheromones, attacked trees may act as centers for attacks of surrounding trees by bark beetles.

Regeneration of these areas with ponderosa pine will not produce anticipated timber yields, but rather will continue the cycle of dwarf mistletoe infection from overstory to understory. Also, the level of infection in the overstory will increase, resulting in a decreased rate of growth and increased chance of mortality. Slowly, as the pines die the stands can be expected to convert to the more shade-tolerant Douglas-fir, white fir, and incense-cedar.

2. Regenerate Non-Host Species. The amount of ponderosa pine in the planting mix would be reduced to a minor component. The larger proportion of non-host species would increase the likelihood of mistletoe seed being intercepted and not serving as inoculum. As the crowns of the non-hosts become larger, they will become better interceptors and the spread of mistletoe from the overstory pines to the understory will be greatly reduced. Some new infections can be expected, and in some cases cause tree stunting and deformity, but many of the pines can be expected to grow normally. Openings left to regenerate by natural





seedfall will not be affected by this approach as the understory ponderosa pine will be infected from the overstory.

Some growth loss can be expected from the more tolerant species. The survival of white fir regeneration will be less than that of ponderosa pine. Considerable deer browse was noted on the Douglas-fir and white fir. Also, some frost damage was observed. These will retard the early growth of these species and possibly extend the rotation length. If these trees do not grow in height at comparable rates as the ponderosa pine in the early years, then their usefulness in intercepting dwarf mistletoe seed will diminish.

3. Dwarf Mistletoe Suppression. Infected ponderosa pines within and around the regenerated areas would be treated to reduce the level of infection and amount of mistletoe seed produced. Treatment would consist of killing infected overstory trees around the openings by either felling or girdling. Some branch pruning of selected trees may be appropriate. Trees for pruning would be those with only a few infections in their lower crowns, with good live crown ratios, growing well, and desirable for stocking. Understory trees with the potential for release following removal of the overstory could be pruned of infections. Regeneration should consist of species mixes to reduce the chance of pine infection.

Although mistletoe eradication might be considered desirable, it is not feasible in these stands without producing large clearcuts or removing all infected ponderosa pines. Rather, the objective should be the suppression of dwarf mistletoe to a level that is acceptable. Acceptability should be based on expected stand growth and the future level of dwarf mistletoe infection.

Because of the multiple layer stand structure, all overstory ponderosa pines around some openings may need to be removed to limit the chance of infection of the understory. This involves removing overstory pines within 100-125 feet of the edge of the opening. Selective removals may be possible around openings where infections levels are low.

Girdling ponderosa pines and leaving them to slowly die may introduce a hazard to nearby residual pines. The girdled pines may be attacked by bark beetles which emit aggregating pheromones. Attracted bark beetles may attack any nearby pine within about 20 feet of the girdled pine, resulting in death of the nearby leave trees. When pines are to be selectively killed for mistletoe suppression, then those in clumps should be felled rather than girdled to reduce the risk of bark beetle attacks.

K Green pine slash produced by suppression activities could become habitat for pine engraver beetles, *Ips* spp., that could emerge and attack nearby pines. Proper slash treatment or disposal should be included in any dwarf mistletoe suppression project. The following measures may be used to reduce the hazard from pine engraver beetles.

-Plan slash creating activities to be done between mid-July and January. This will allow slash to dry out before insect populations can build.





-Treat all pine slash greater than 3 inches in diameter. Smaller diameter material is not suitable habitat for engraver beetles.

-Treatments can include lopping and scattering to expose boles to the sun, crushing with machinery, piling and burning within 6 weeks, chipping, removing from the site, bucking pieces to lengths less than 18 inches.

-Do not allow green slash to lay against leave trees. Keep it several yards away.

McCOY RIDGE

This is an 84 acre ponderosa pine/sugar pine plantation on McCoy Ridge (T. 21 N., R. 10 W., section 15). Trees are sapling and pole-size. The adjacent ponderosa pine stand is infected by western dwarf mistletoe. This overstory stand was part of a timber sale that was not completed. The area does not contain sufficient volume to support a sale and no nearby areas are included in the 5 year timber sale plan. Mistletoe seeds are beginning to land on the sapling-size plantation trees with new infections becoming obvious. White pine blister rust infections (caused by Cronartium ribicola) are present in the lower branches of many of the sugar pine in the plantation. Some infections are beginning to enter the boles.

Management Alternatives

1. No Action. Additional dwarf mistletoe infections will occur in the plantation trees, both by spread of seed from the overstory and tree to tree spread within the plantation. As the plantation trees become more heavily infected throughout their crowns, their growth will be adversely affected and some may become deformed. Most of the sugar pines will die from blister rust infection before they become merchantable. This may result in some small holes in the stand and reduce the effectiveness of sugar pine in limiting mistletoe spread by seed interception. Yields from this plantation will be less than projected.

2. Mistletoe-free Buffer. An opportunity exists to reduce the future effect of dwarf mistletoe in this plantation. An infection free area would be created between the plantation trees and the infected stand to reduce the chance of mistletoe spread into the plantation. Based on the height of the infections, the buffer area should be 100 feet across where infested areas abut the plantation. It would be preferable to remove all ponderosa pines within this buffer. However, it may be possible to remove only the infected overstory trees. If this is done, then the buffer area should begin at the edge of the plantation and extend into the stand 100 feet. Close monitoring for 3-5 years after treatment will be required if this latter option is selected to ensure that infected overstory trees that might be missed in the initial treatment do not remain in the stand. This would eliminate additional mistletoe infections of the plantation pines from the overstory. An understocked or non-stocked area would exist between the stand and the plantation. Eventually natural regeneration, mainly ponderosa pine, would invade the buffer area. If infected trees are in the stand along the edge of the buffer, then this regeneration





would become infected. The likelihood of significant reinfection of the plantation pines from this source would be minimal because of the time required for the mistletoe to spread and the much larger size of the plantation trees compared to the infected natural regeneration.

3. Regenerate the Overstory Stand. Trees in the plantation are of sufficient number and size to qualify the area as being stocked. The adjoining stand could be harvested and regenerated, thereby eliminating the dwarf mistletoe hazard. Boundaries of the harvest unit should be established to include the mistletoe infested area. If this is not feasible, then the planting stock along any infected boundary should only include a small proportion, if any, of ponderosa pine. Removing the overstory ponderosa pines would eliminate additional infections from above of the ponderosa pine plantation trees. The existing plantation would not be impacted by dwarf mistletoe. The amount of dwarf mistletoe in the overstory trees is not having a significant effect on tree growth and, therefore, retaining or removing these trees will not alter the productivity of the site as far as the influence of dwarf mistletoe.

4. Harvest Infected Trees. A sanitation harvest in the overstory stand would be done to remove all dwarf mistletoe infected trees. If infected trees are not merchantable, they should still be felled or girdled. This would remove the overstory source of infection and allow the plantation to grow without further infection. Stocking in some areas of the stand, however, may be reduced below acceptable levels. Small patch cuts that are created may be regenerated, although a more shade-tolerant species than ponderosa pine should be planted. It is likely that some infected trees would be missed during harvesting. Those within the stand would not cause much hazard, but close examination of trees along the boundary with the plantation would be necessary to remove all sources of overstory infection.

5. Prune Plantation Trees. This activity should not be pursued if the source of mistletoe infection from above is not treated as discussed in numbers 2-4 above. The few mistletoe infected branches in the plantation would be removed. This would eradicate the dwarf mistletoe from this area if all infections are found.

If the plantation were managed to maintain a rate of height growth of 10 or more inches per year, then the need for mistletoe eradication is questionable. A managed stand with this rate of growth can tolerate some mistletoe infections, as long as an overstory source of mistletoe seed is not present. The amount of uninfected crown added each year would exceed the vertical spread rate of dwarf mistletoe, thereby increasing the proportion of uninfected crown each year.

Some of the blister rust infected sugar pines could benefit from branch pruning. Care would be needed to select the proper trees for pruning. Trees eligible for pruning would need to have no bole infections or branch infections within 4 inches of the bole. Trees with such infections will be killed by the rust regardless of any pruning. Sugar pines should be pruned of all branches up to 50% tree height or as high as can be reached, whichever is less. Trees with infections higher than this should not be pruned unless the individual infection is more than 4 inches from the bole and is removed.





NEWHOUSE RIDGE

A ponderosa pine, Douglas-fir, and sugar pine plantation was created several years ago on Newhouse Ridge (T. 22 N., R. 11 W., section 14). Seedlings in this 50 acre plantation are 2-4 feet tall. Some overstory ponderosa pines infected by dwarf mistletoe were left in the plantation and along the edge. In the northwest corner of the plantation, existing ponderosa pine regeneration was left when the area was site prepared. A number of these seedlings are infected by dwarf mistletoe and are stunted and deformed. Infections of the planted ponderosa pines were not observed.

Management Alternatives

1. No Action. Dwarf mistletoe will eventually infect the planted ponderosa pines in the vicinity of infected overstory trees. The infected regeneration will be stunted and deformed and will not grow to their potential. Spread of dwarf mistletoe in the plantation beyond the influence of the overstory trees will be slow and will not cause much impact to the plantation. The infected natural regeneration will also act as a source of infection. Although the rate of horizontal spread will not be as great as from the overstory trees, they have sufficient height advantage to spread seed. Also, as they become larger they will continue to be heavily infected and will act as a potential center for bark beetle activity that may spill over into the plantation.

2. Remove Source of Infection. Infected overstory ponderosa pines within and around the edge of the plantation would be treated. Treatment would involve harvesting, felling, or girdling the trees (See comments on girdling under Buckhorn Ridge, #3 above). The infected natural regeneration in the northwest corner of the plantation should also be removed to eliminate this source of infection.

TWIN ROCKS RIDGE

This ponderosa pine and black oak stand (T. 22 N., R. 10 W., section 4) of mature trees extends onto private land on one side and abuts a Penny Pines plantation of ponderosa pine on the other. Visual management objectives of partial retention limit the size of any openings. Dwarf mistletoe is present in the overstory and understory ponderosa pines on both the National Forest and private lands. The severity of infection increases eastward from the Penny Pines plantation onto the private land. The infestation does not extend into the plantation. This plantation is somewhat protected by about a 50 foot opening along the edge adjacent to the infested natural stand.

Management Alternatives

1. No Action. Dwarf mistletoe will slowly intensify in the natural stand. Heavily infected trees will periodically die, especially when additional stress factors such as drought occur. These trees will likely be attacked by bark beetles and may serve as foci for attacks on surrounding pines. Some infections may spread into the Penny Pines plantation. However, because of the amount of time required for the entry of dwarf mistletoe into this plantation and for it





to intensify to significant levels, there will not be much impact on plantation productivity, assuming a normal rotation length for a timber stand. If other objectives necessitate lengthening the rotation, then dwarf mistletoe could begin to have an adverse effect on tree vigor.

2. Thinning. Stocking levels would be adjusted for the site. A thinning from below would remove many of the infected understory trees. Some heavily infected overstory trees should also be removed. Thinning the stand would reduce intertree competition and the associated stress of insufficient soil moisture. Most of the residual trees should respond favorably to these conditions and be less susceptible to successful bark beetle attacks. Some should have an increased rate of growth which may decrease the proportion of crown infected by dwarf mistletoe.

3. Regenerate with Non-Hosts. Any natural regeneration in this stand will likely be ponderosa pine and should not be relied on as a component of the future stand. Patch cuts of 1-2 acres will be required to provide sufficient opening for regeneration of a non-host. Douglas-fir would probably be appropriate to the site and would not be a host for western dwarf mistletoe. Regeneration cuts of this type will satisfy the visual management objective and reduce the spread and long-term effect of dwarf mistletoe on the stand. Regenerating a patch cut with Douglas-fir along the boundary with the Penny Pines plantation would eliminate the hazard of dwarf mistletoe entering the plantation from the infested stand.

ATCHINSON TIMBER SALE

A series of clearcut units were harvested in the Atchinson timber sale T-3 and T-4 (T. 22 N., R. 10 W., section 24 and T. 22 N., R. 9 W., sections 20 and 29, and R. 10 W., sections 24 and 25) and are to be planted in 1990. The planting stock includes ponderosa pine (45%), Douglas-fir (45%), and sugar pine (10%). The surrounding stands are comprised of ponderosa pine, Douglas-fir, and black oak. In some portions of the area dwarf mistletoe is present in the ponderosa pine and poses a threat to the pine regeneration. The amount of dwarf mistletoe in the residual stands varies from being a light infection in only a few trees to being common in most of the surrounding ponderosa pines.

Management Alternatives

1. No Action. Within 10-15 years dwarf mistletoe will begin to spread from the overstory ponderosa pines into the regeneration. Distance of spread into a plantation will depend on the general height of the dwarf mistletoe in the overstory, where the infection source is located on the slope in relation to the plantation, and the direction and speed of the prevailing winds. The seedling mix around the edges of the plantation will determine the likelihood of infection and subsequent spread in the plantation.

Plantation pines around the edges may be reinfected each year and will become stunted and deformed. Seedlings further in the plantation may become infected as the dwarf mistletoe spreads from seedling to seedling, but most infections will be in their lower branches and will not adversely affect them if they are





growing adequately in height. Pines within the plantation that are suppressed will be impacted more severely.

2. Remove Infected Overstory Pines. Around some units only a few trees are infected that are close enough to be a source of infection. These individual trees could be felled, girdled, or removed to eliminate the chance of dwarf mistletoe entry into the plantation. Another option would be to harvest adjacent units within 10 years of planting the existing units. This would also eliminate the source of infection. The size and shape of the adjacent units should take into account the extent of the dwarf mistletoe in the area. If possible, the harvest unit should include all of the dwarf mistletoe infested area.

The trees planted in 1990 may not be of sufficient size in 10 years to permit regenerating the adjacent areas without violating unit size and dispersion requirements. Partial cuts may be possible that would thin the adjacent stands and remove the infected pines along the edges of the plantations. This could provide sufficient volume to make the sale feasible, but still leave adequately stocked stands for future harvest.

3. Adjust Planting Mix. When planting units with dwarf mistletoe in the surrounding stand, the proportion of ponderosa pine planted around the edge would be reduced. Because of white pine blister rust, the proportion of sugar pine planted should not be increased. Rather, Douglas-fir should be increased to become the primary species. A suggested mix would include 65-70% Douglas-fir, 20-25% ponderosa pine, and 10% sugar pine. Approximately a 100-150 foot deep area around the periphery of the plantation would require this mix. With increasing distance from the edge, the proportion would change to an increasing amount of ponderosa pine. The overall species mix in the plantation would remain unchanged.

Some of the periphery ponderosa pines may become infected by dwarf mistletoe. Because of their low proportion and the mix of non-host species, the spread of dwarf mistletoe into the stand will be limited. Planting a small amount of ponderosa pine around the edge of the plantation will reduce the risks associated with regenerating an area with a single species.

DISCUSSION

The stands we examined on Buckhorn Ridge and Newhouse Ridge are appropriate for direct suppression of dwarf mistletoe. Removing infections by pruning in the plantation on McCoy Ridge would also be appropriate if some treatment of the adjoining stand was done to remove the source of overstory infection. The other two areas, Twin Rocks Ridge and Atchinson timber sale, can be addressed indirectly through silvicultural practices and timber sale activity.

Financing for direct suppression of dwarf mistletoe is available from the Region (see FSM 3430). Funds necessary for presuppression survey efforts to collect data to request suppression funding are also available. A proposed control project requires the following documentation.





Forest Supervisor, Mendocino NF

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- 1) An environmental assessment or environmental impact statement, as appropriate.
- 2) A biological evaluation that substantiates the need and proposed strategies of the project.
- 3) An economic evaluation that reflects benefits and costs.
- 4) A project work plan.
- 5) A FPM Project Proposal, FS-3400-2.

This document constitutes the biological evaluation. We are available to provide additional biological information that may be necessary to complete any environmental documentation and economic analysis. Hopefully, the District will pursue suppression activities in these areas to reduce the future impacts of dwarf mistletoe.

If you have any questions about this report or need additional assistance, please contact me at the Shasta-Trinity Supervisor's Office (916-246-5101).

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